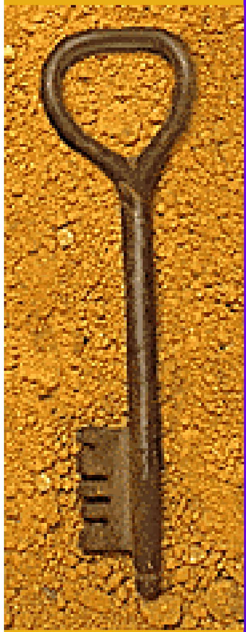

NUTRITION CONCERNS IN THERMAL INJURY

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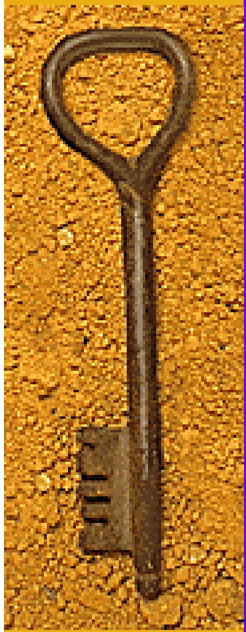
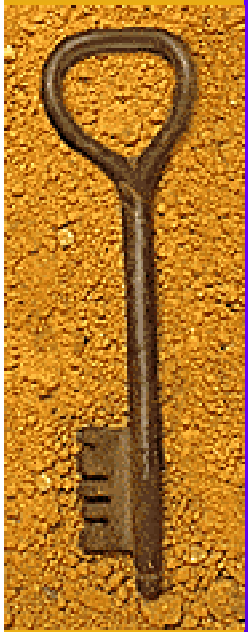


NUTRITIONAL DILEMMAS

1. “How” do I feed my patient?
2. “When” should feeds begin?
3. “How long” will the patient require additional nutrition support?
4. “What” do I feed the patient?
5. “How much” do I feed the patient?



CLASS OBJECTIVES

- Describe the initial metabolic processes impacting nutrition support for the burn patient: The “how,” “when,” and “how long” to feed dilemmas.
- Identify current methods/tools used by the ISR for determining nutrition requirements for patients with thermal injury: The “what” and “how much to feed dilemmas.
- Discuss dietary considerations for long-term burn recovery and future directions for nutrition support: “Food for thought.”

BIOCHEMICAL ALTERATIONS:

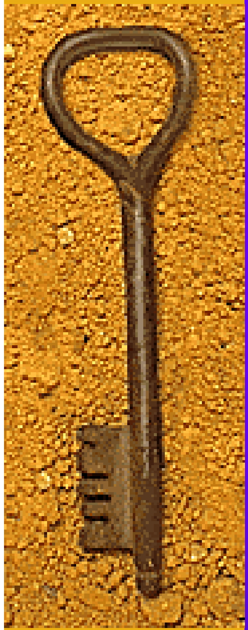
Increased protein losses/altered amino acid transport system:

1. Rate of protein catabolism elevated in excess of protein synthesis=net protein/nitrogen loss

2. ~50% body protein converted to glucose in stress

3. Nitrogen loss as high as 40-60g/day=250-375 g protein equivalent to 2 – 3 lbs muscle/day.

4. Increased nutritional protein does not stop catabolism, rather it serves in synthesis of lost tissue



METABOLIC ALTERATIONS FOLLOWING BURNS

- Ebb Response
  - Fluid Resuscitation
  - Prevent Shock
- Flow Response
  - Hypermetabolism
  - Catabolism

FLUID RESUSCIATION

- Second and third degree only
- Based on burn size and weight
- Weight: pre-burn weight
- Overestimation is common
- Fluid: Lactated Ringers
- Adults: 2-4 cc/kg/% BSA burn
- Child <30 kg: 3-4 cc/kg/% BSA burn

FLUID RESUSCIATION

- 1/2 volume during the 1st 8 hrs
- 1/2 during the 2nd 16 hrs
- Example: 70kg male with 50% TBSA burn will require 7-14L volume in the 1st 24 hrs
- LR rate is adjusted in response to UOP
- Goal: 30-50 cc/hr in adult

THREE LEVELS of FLOW PHASE

- **LEVEL 1**:Peak: ~7 days post burn
- **LEVEL 2**: Declines over time in direct proportion to degree of wound healing/closure
- **LEVEL 3**: Follows wound closure=LBM, strength & endurance restored

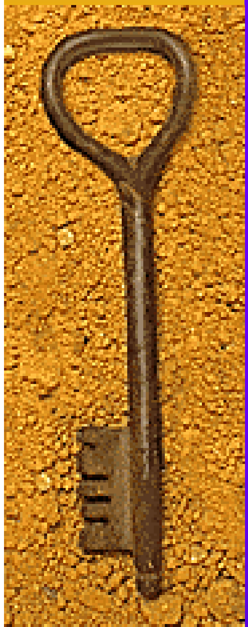
ALTERED GASTROINTESTINAL FUNCTIONS: TIMING OF FEEDS

1. GI tract prone to deterioration of gut barrier function=increased gut permeability

2. Deterioration begins 1st 24 – 48 hrs post-burn

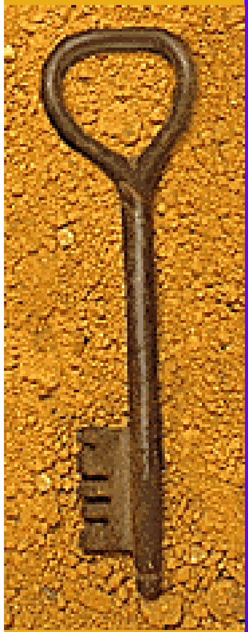
3. Potential for GI ileus 1st 48 – 96 hrs post-burn

4. Early feedings=decreased energy needs, + N-balance, potential for improved morbidity and mortality in burns



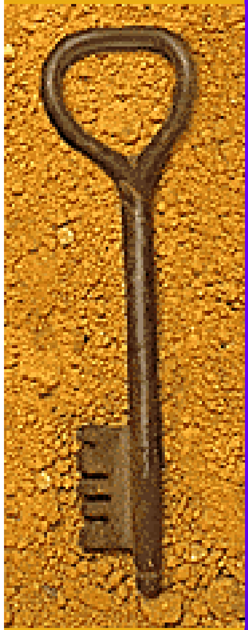
NUTRITION ASSESSMENT COMPONENTS OF NUTRITION HISTORY

1. Past & current diagnoses of nutritional consequences
2. Diagnostic procedures (if applicable)
3. Surgeries
4. Hx for chronic therapies (ex: chemotherapy, radiation Tx, etc.)
5. Hx for nutrition related problems (ex: morbid obesity)
6. Existing nutritional deficiencies
7. Food/Drug interactions
8. Psychosocial Hx: ETOH, drugs, financial needs



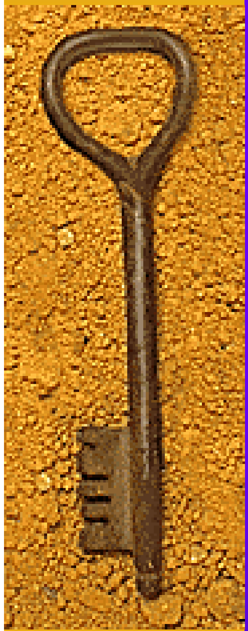
FACTORS THAT MAY AFFECT METABOLIC RATE IN BURN PATIENTS

- Activity
- Age
- Body composition
- Body temperature
- Circadian rhythm
- Dry heat loss (ambient temperature)
- Energy cost of protein synthesis
- Energy cost of respiratory stress
- Evaporative heat loss (wound coverage)
- Gender
- Immediate versus delayed feeding
- Infection
- Non-burn trauma
- Pain
- % Body surface area burned
- Sleep versus awake state: sleep stages
- Specific dynamic action of food (thermogenic effect)
- Surgery



NUTRITION ROUTES

- Oral
- Enteral
- Parenteral
- Combination



ORAL INTAKE

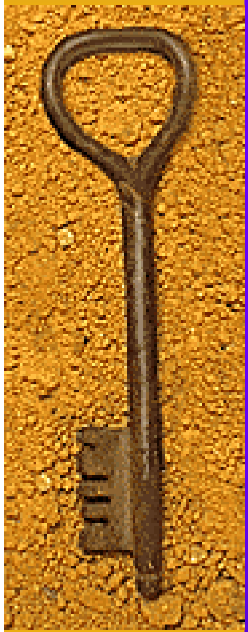
- Feeding route of choice
- Patient preference
- High calorie, high protein supplements
- Assisted feeding
- Calorie Count to assess adequacy

LIQUID SUPPLEMENTS

240CC/8OZ	Kcal	Protein
Resource Plus	360	13
Ensure HP	225	12
Resource Juice	250	09
Milk, whole	150	08
“Homemade” Shake	350	16

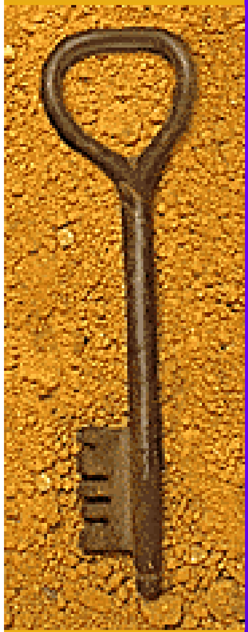
ENTERAL FEEDINGS

- Patients with ≥30% TBSA burn
- Duodenal or jejunal placement beyond ligament of Treitz
- Initiated at full strength (isotonic)
- Isotonic formula with intact proteins
- 4 hour volume in feeding bag
- Modular protein via bolus feeds



ENTERAL FORMULAS

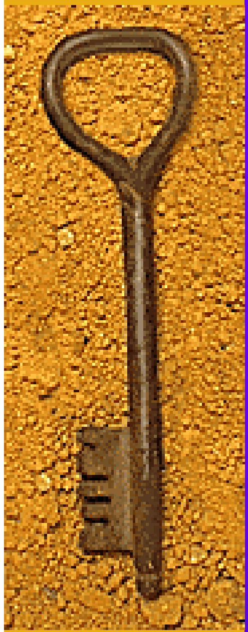
Formula	Calories/mL	Protein g/L	Osmolality
Osmolite HN Plus	1.2	55.5	360
Osmolite	1.06	37.1	300
Two Cal HN	2.0	83.7	690
Peptinex DT	1.0	50.0	460
Novasource Renal	2.0	69.9	635
Resource for Kids	1.0	30	345

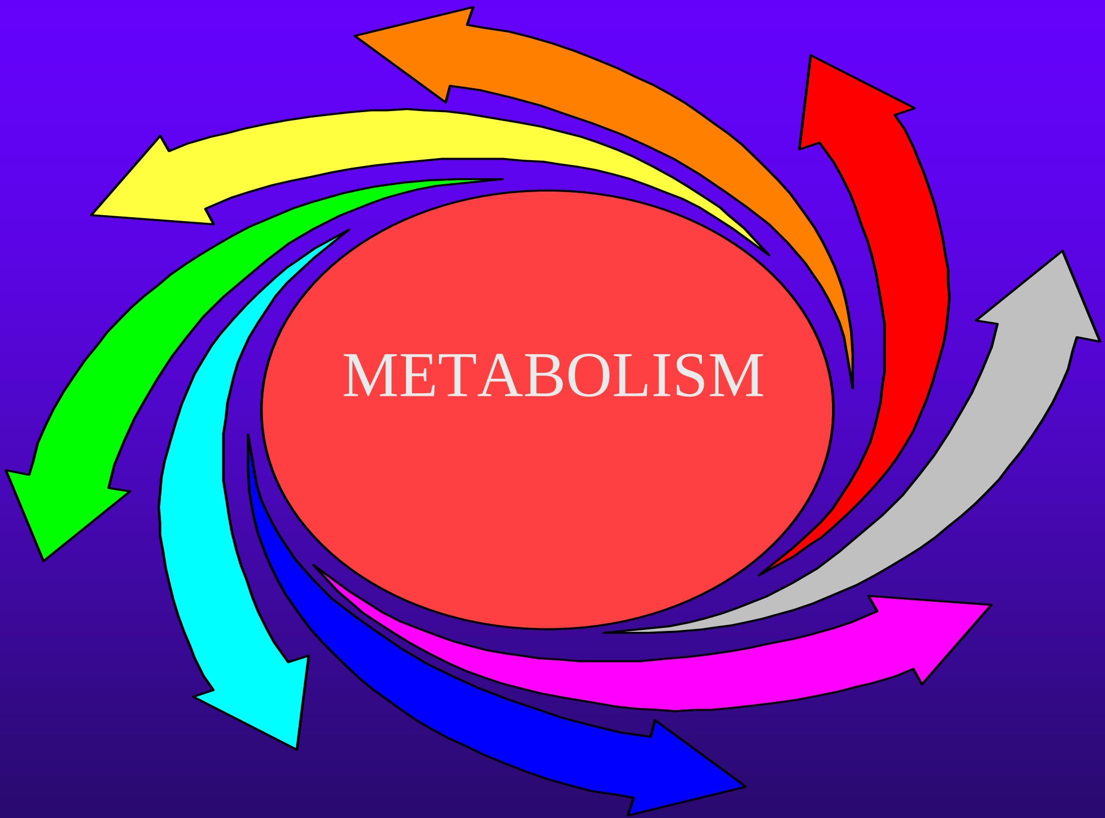


PARENTERAL FEEDINGS

- Least desired
- Follow A.S.P.E.N. guidelines
- Three-in-one administration of amino acids, dextrose, lipids
- Goal to keep glucose load <5mg/kg/min, lipids <1gm/kg/d

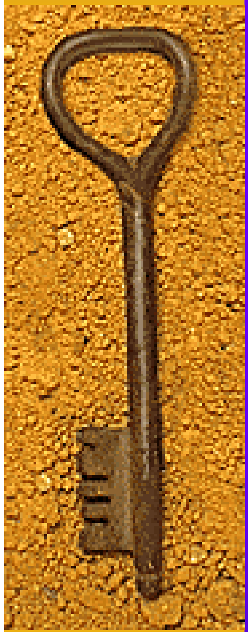
DETERMINING ENERGY & NUTRIENT NEEDS





CARBOHYDRATE (CHO)

- CHO= bulk of calories=>60%
- CHO serves to “spare” protein
- Normal conditions: nutritional requirement ~100 grams or ~400kcal/day
- Burns/stress: body’s maximum glucose oxidation ability= 5 mg/kg/min which is ~7 g/kg/day
- Excess CHO = excess CO_2 production

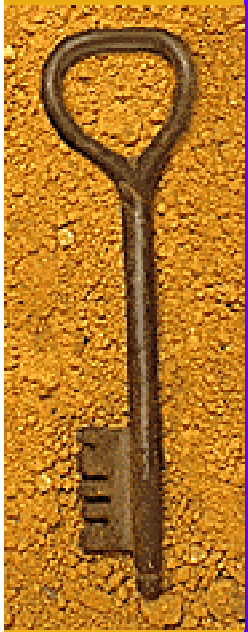


FAT/LIPID REQUIREMENTS

- Lipids = limit in TPN due to immuno-suppressive tendencies: 15 – 20% or <30% total calories
- Prevention of essential fatty acid deficiency=1 – 1.5% total calories as fat
- Omega-3 fatty acids shown more beneficial than omega-6 FA

PROTEIN REQUIREMENTS

- Protein = greatest increase in burn injury
- ~1.5 - 2.5 gm Protein/kg admit wt; 100 NP Kcal: gm Nitrogen; ~20-25% Total Kcal/day for adult
- Amount of pro breakdown proportional to size of burn
- Pediatric burn patient: Protein needs greater due to growth needs, age dependent



PROTEIN REQUIREMENTS FOR BURNED PATIENTS

AGE (years)	Protein (g/kg body wt)
0 – 0.5	4.4
0.5 – 1	4.0
>1	2.0
Adult	1.5-2.5

PEDIATRIC ENERGY NEEDS

- Galveston Shriners, Hildreth, et al,:
  - JBCR 09(6):616, 1988
  - JBCR 11(5):405, 1990 > 12 yrs
  - JBCR 14(1):108, 1993 < 01 yr
- RDA, National Research Council,

Recommended Dietary Allowances, 1989

Galveston Infant

- 0-1 years
- 2100 kcal/m^2 + 1000 kcal/m^2 burn
- Example: 11-month old, 10 kg
- BSA = 0.5 m^2
- Calorie needs: 1250 kcal/d

Galveston Revised

- 1-11 years
- 1800 kcal/m^2 + 1300 kcal/m^2 burn
- Example: 3-year old, 12 kg
- 40% TBSA burn
- BSA = 0.6 m^2
- Calorie needs: 1392 kcal/d

Galveston Revised

- 1-11 years
- 1800 kcal/m^2 + 1300 kcal/m^2 burn
- Example: 10-year old, 30 kg
- 40% TBSA burn
- BSA = 1.1 m^2
- Calorie needs: 2552 kcal/d

Galveston Adolescent

- 12-18 years
- 1500 kcal/m^2 + 1500 kcal/m^2 burn
- Example: 14-year old, 60 kg
- 40% TBSA burn
- BSA = 1.6 m^2
- Calorie needs: 3360 kcal/d

Determining Body Surface Area (BSA)

- 1916 Dubois equation:

  BSA (m^2) = 0.007184 x (Weight (kg) $^{0.425}$ x Height (cm) $^{0.725}$)

- Simplified equation:

  BSA (m^2) = square root of

  $$\frac{\text{Ht (cm) x Wt (kg)}}{3600}$$

- Nomograms

TOOLS FOR DETERMINING ADULT ENERGY NEEDS

- 1960s: Harris-Benedict Equation: based on wt/kg, ht/cm, age/yrs. Added injury or activity factors.
- 1970s: Curreri-Predictive equation for burns using both age and body surface area burned. No upper limits so could overfeed.
- BAMC ISR Equation

TOOLS FOR DETERMINING ADULT ENERGY NEEDS

Example:

- 25-year old male
- 71 inches
- 80 kg
- 60% TBSA

Harris Benedict with Stress Factor (Wilmore)

BEE X Stress factor for %TBSA burned

- <10%: 1.3
- 10-24%: 1.4
- 25-34%: 1.55
- 35-44%: 1.7
- 45-54%: 1.85
- 55-99%: 2.0

Example patient: 3788 kcal

Curreri Formula

- Age 16-59 years:

  [25 kcal x preburn wt (kg)] + [40 kcal x %TBSA]

- Age >60 years:

  [20 kcal x preburn wt (kg)] + [65 kcal x %TBSA]

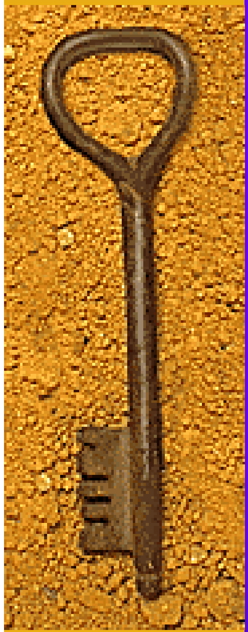
- Example patient: 4400 kcal

ISR PREDICTIVE EQUATION

EER = (BMR X (0.89142 + (0.01335 X TBSA))) X BSA X 24 X AF

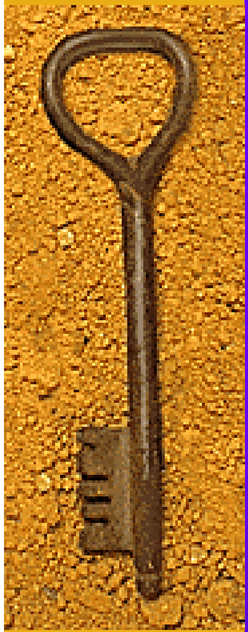
- **EER = Estimated energy requirement**
- **BMR = Basal metabolic rate using Fleish equation**
- **TBSA = Total body surface area burn (i.e., for 30% use "30")**
- **BSA (m^2) = Body surface area using reputable calculation method**
- **AF = Activity factor (use 1.25 or as appropriate for patient)**

Example patient: 3802 kcal (~48 kcal/kg; rate of 135ml/hr using Osmolite HN+)



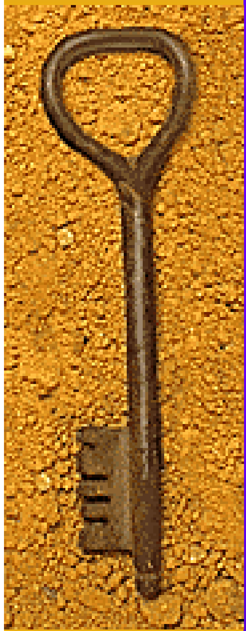
ASSESSMENT OF NUTRITIONAL ADEQUACY

- Calorie Count
- Indirect Calorimetry
- Nitrogen Balance
- Thermodilution Fick Equation
- Wound Healing
- Weight Change



INDIRECT CALORIMETRY

- INDIRECT CALORIMETRY
  - Measures CO_2 production
  - Measures O_2 consumption (VO_2)
  - Calculates respiratory quotient
  - Calculates basal metabolic rate (BMR)



ISR NITROGEN BALANCE EQUATION

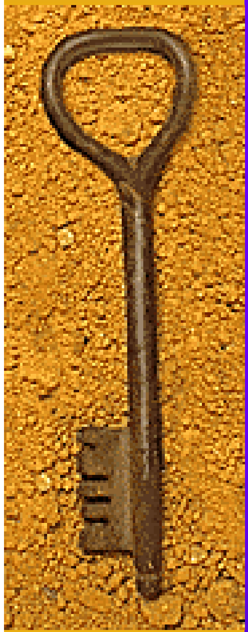
- NITROGEN BALANCE
  - N_2 in - N_2 out = BALANCE
  - N_2 in = gm PRO/6.25
  - N_2 out = (UUN X 1.25) + 2 + WAXMAN

WAXMAN EQUATION

- PBD 1-3: gm N_2 = 0.3 x BSA x % TBSA burn
- PBD 4-16: gm N_2 = 0.1 x BSA x % TBSA burn
- PBD >16: gm N_2 = 0.1 x BSA x % Actual TBSA burn (actual TBSA burn determined open at time)
- PBD = Post-Burn Day

THERMODILUTION FICK EQUATION

- REE = C. O. x Hgb (SaO_2-SvO_2) x 95.18
- Some correlation with IC but not yet proven in burn patients
- Use only with Swan Ganz catheter required so limited in application
- Use only when unable to perform IC

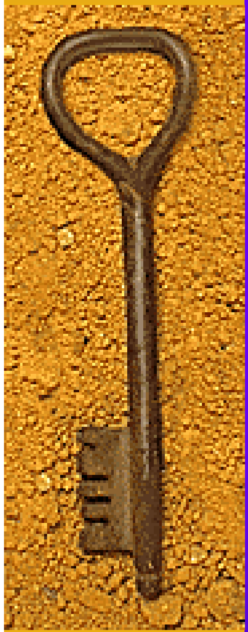


TRANSITIONAL FEEDING NEEDS

- Tube-Feeding until oral intake ~75-80%
- Combination feeds: PM Tube Feeds plus day time oral diet
- Adaptive needs: Long-term OT rehab for self-feeding skills
- Increased energy expenditure: OT, PT, minor surgeries

FOOD FOR THOUGHT

- Amino Acids: Arginine, glutamine
- Vitamins and Trace Minerals (adults): Multivitamin, Vit C (500 mg BID), Vit A (10,000 IU per day), Zinc (220 mg per day)
- Wound healing "enhancers:" Oxandrolone, growth hormone, insulin



REVIEW of CLASS OBJECTIVES

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QUESTIONS???